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AFATL-TR-67-135

Qualification Testing of the FMU-68/B Fuze

E. J. Abt
Honeywell, Inc.

TECHNICAL REPORT AFATL-TR-67-135

OCTOBER 1967

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AIR FORCE ARMAMENT LABORATORY
AIR FORCE SYSTEMS COMMAND
EGLIN AIR FORCE BASE, FLORIDA

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QUALIFICATION TESTING OF THE FMU-68/B FUZE

E. J. Abt

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FOREWORD

The qualification testing of the FMU-68/B fuze was conducted by Honeywell Ordnance Division, 600 Second Street North, Hopkins, Minnesota, under the technical direction of the Air Force Armament Laboratory(ATCC), Eglin AFB, Florida 32542. The effort was accomplished from June 1966 to October 1966 in accordance with the terms of Air Force Contract 08(635)-6041.

The qualification testing was monitored for the Air Force by Lt. Gary McCollum, Air Force Armament Laboratory (ATCC).

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JOHN E. HICKS, Colonel, USAF
Chief, Bio-Chemical Division

ABSTRACT

This report covers the qualification testing of the FMU-68/B fuze, conducted under the direction of the Air Force Armament Laboratory, Eglin AFB. The test program consisted of an evaluation of performance and sensitivity characteristics of 436 fuzes in applicable military standard environments. During the tests, data were accumulated shwoing that the fuze had a function reliability of 0. 973 at the 0. 90 confidence level and an abort reliability of 0. 956 at the 0. 90 confidence level. These high reliability levels indicate that the FMU-68/B fuze is apparently qualified for Air Force use.

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SECTION I

SUMMARY

During the course of this contract, a qualification test program was conducted on 358 FMU-68/B fuzes. One thousand fuzes were supplied to the Air Force.

At the beginning of the program, the fuze design had performance deficiencies. However, after modifications were made to the rotor, rotor spring, and the seal between the adapter and case; the FMU-68/B successfully passed all the tests to which it was subjected. A summary of these test results appears in table I. In this table, the stated reliability for the larger sample sizes is believed to be representative of fuze performance.

The following describes the FMU-68/B fuze performance which was demonstrated at the end of the contract:

Function reliability is 0.973 at the 0.90 confidence level.

Abort reliability is 0.956 at the 0.90 confidence level.

Free fall of armed fuzes from a height of 13.7 inches will cause 50 percent of the fuzes to function when they impact along their least sensitive axis.

Fuzes do not leak or degrade significantly when exposed to extreme climatic conditions.

Fuzes remain safe and, in many cases, operable after subjection to severe physical environments.

Vibration and rough handling environments do not degrade fuze safety or functioning characteristics.

Mass production techniques should permit even higher product reliability attainment.

TABLE I

SUMMARY OF QUALIFICATION TEST RESULTS FOR FM6-68/B FUZES

TEST	TEST QUANTITY	PASSED	RELIABILITY AT THE 0.90 CONFIDENCE LEVEL
NORMAL ABORT	91	90	0.956
FUNCTION	144	143	0.973
40-G ARM	31	30	0.87
40-G FUNCTION	20	19	0.81
TRANSPORTATION VIBRATION	37	37	0.937
SALT SPRAY	5	5	---
SENSITIVITY	30	N/A*	N/A*
WATERPROOFNESS	5	5	---
TEMPERATURE AND HUMIDITY	14	14	---
AIRCRAFT VIBRATION	15	15	---
40-FOOT DROP	5	5	---
JOLT	12	12	---
JUMBLE	12	12	---
FIVE-FOOT DROP	15	15	---

* NOT APPLICABLE

SECTION II

BACKGROUND

The FMU-60/B fuze was designed for use in BLU-29/B firebombs carried in SUU-24/A dispensers. FMU-68/B is the designation assigned to a variation of the FMU-60/B, modified to conform to the fuzing requirements of conventional napalm firebombs, including the BLU-1/B, BLU-23/B, BLU-27/B, and BLU-35/B in their finned and unfinned versions.

SECTION III

FUZE REQUIREMENTS

In addition to the customary climatic and physical environmental requirements which bomb fuzes are expected to withstand, the FMU-68/B fuze must exhibit the following:

> Fuze arming will be terminated before the full-arm condition is reached if a fuzed bomb experiences normal release from less than 3. 2 feet above ground. (During the course of the contract, this requirement was revised from "3. 4 feet" to "3. 2 feet. ")
>
> The fuze will arm from 0. 50 to 0. 70 second after normal release of the bomb. (During the course of the contract, this requirement was revised from "0. 46 to 0. 66 second" to "0. 50 to 0. 70 second. ")
>
> The fuze will arm within the specified time limits while being subjected to 40-G axial acceleration of the type experienced during end-over-end tumbling of unfinned bombs released from aircraft.

SECTION IV

TECHNICAL DISCUSSION

1. FUZE CONFIGURATION AT THE OUTSET OF THE PROGRAM

Figure 1 presents the fuze configuration as it was at the beginning of the contract. At that time, detail parts drawings were on class II format, and the fuze was designated "CB-27" within Honeywell because an FMU number had not yet been assigned.

The 36-gram tetryl burster charge was loaded in three equal increments, with each increment enclosed in an aluminum casing. Because burster charge requirements had not been previously fixed by the Air Force, this system of "canning" the burster increments permitted the last minute choice of three burster charge sizes (12 grams, 24 grams, or 36 grams). The pellets could be bonded in place in the adapters just prior to flight test.

A cloth warning tag was attached to the safety wire.

The arming wire hole and safety wire hold were coplanar.

The exposed end of the arming pin assembly was flush with the top of the collar.

The spring retainer was clipped over the case and collar without benefit of additional support.

A flat rubber washer was used to seal the joint between the case and the adapter.

The rotor spring in the housing assembly provided from 0.46 to 0.66 second static arming time.

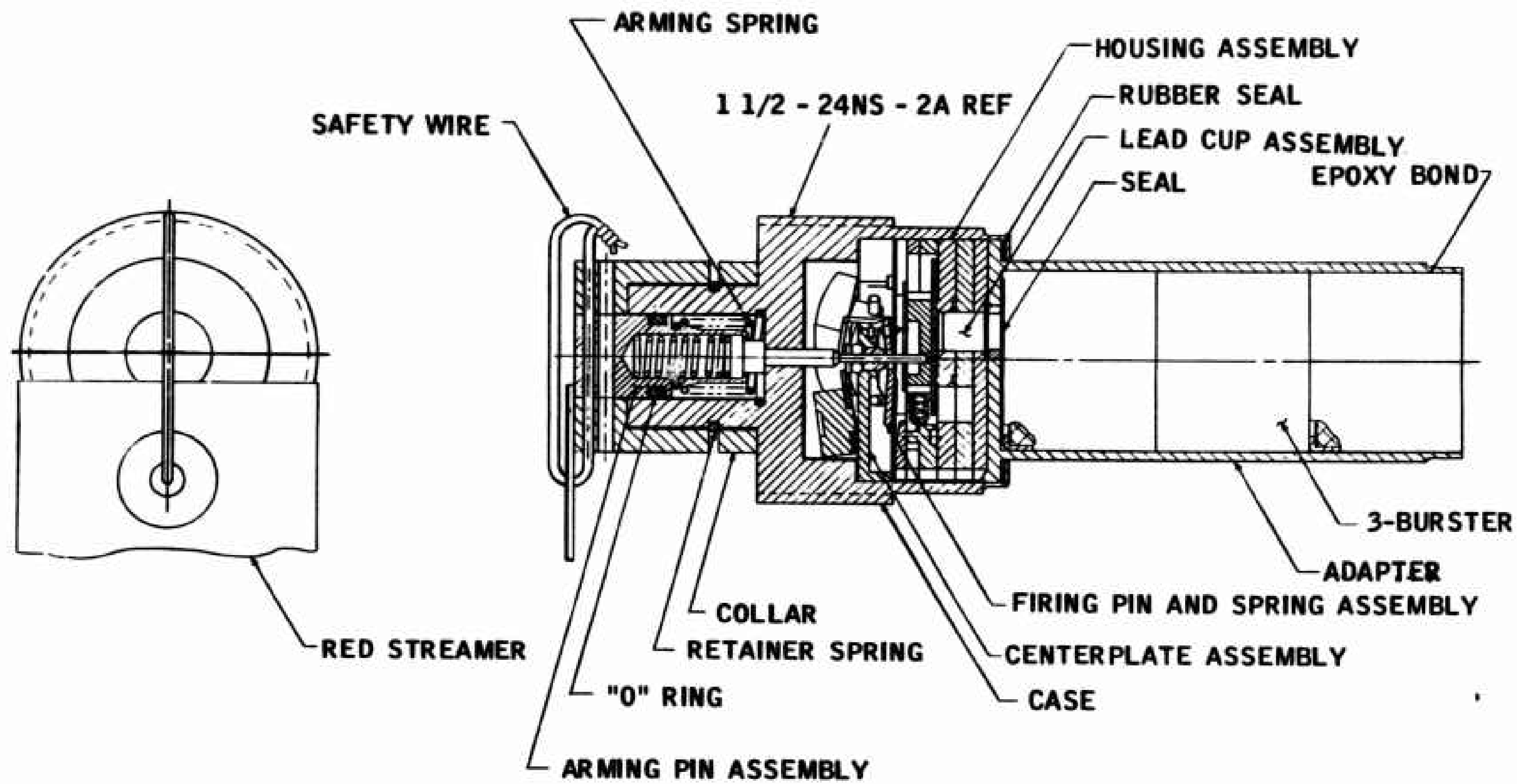


Figure 1 - FMU-68/B FUZE AT BEGINNING OF CONTRACT PERIOD

The rotor gear in the housing assembly contained a kidney-shaped recess that terminated at a point which permitted a "dead zone" wherein the fuze would neither fire nor abort when the fuze experienced particular release conditions.

2. THE COURSE OF DESIGN MODIFICATIONS MADE DURING THE CONTRACT

Figure 2 presents the fuze configuration at the end of the contract period. The development of the design from what it was in figure 1 to what it became in figure 2 is discussed in this section.

In addition to conducting a qualification program for the FMU-68/B fuze, a quanitity of 1,000 fuzes was to be supplied to the Air Force. Of these 1,000, 500 were to be of a "final" design containing a 36 gram burster charge. The remaining 500 were to be shipped with separate burster charges in such a way that one, two, or three 12-gram burster increments could be assembled in the fuze adapter just prior to flight tests. To satisfy this requirement, the adapter was redesigned to include a counterbore on its open end, and the inside diameter of the adapter was dimensioned to accomodate both the "canned" burster pellets and a new burster pellet which was simply a cylinder of tetryl.

When the new pellets are used, three increments are dropped in place; a felt pad, a metal closing disk, and a seal washer are assembled in that order; and the adapter is crimped over the seal washer to form a water-tight assembly. The internal shoulder on the adapter permits the crimp pressure to be confined to the metal closing disk and seal washer, while the burster pellets experience only the load applied by the felt pad.

During preparation of fuzes for shipment from the factory, the red cloth warning tag attached to the safety wire would normally be folded and banded so that it occupies a minimum of space. This practice is

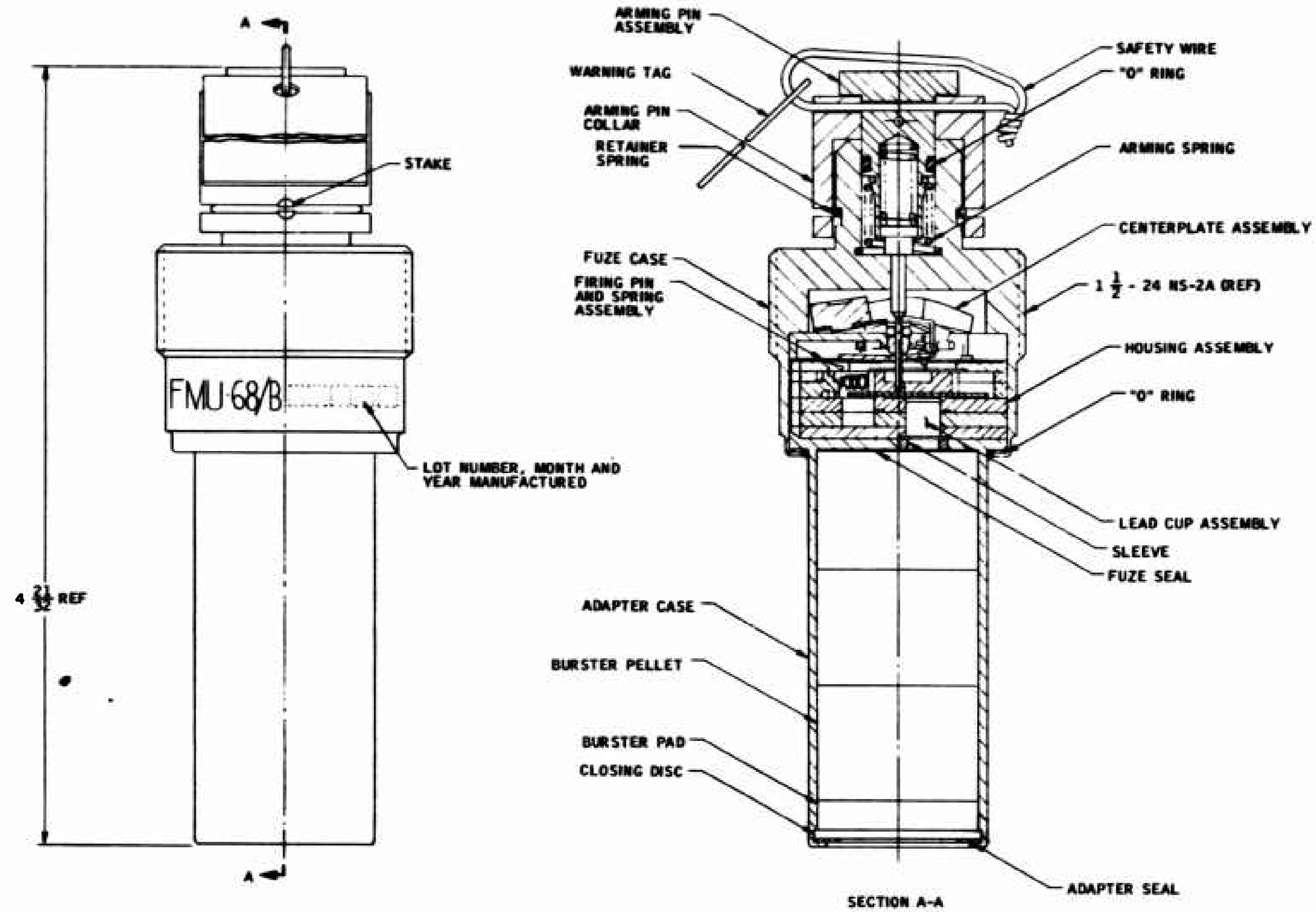


Figure 2 - FMU-68/B FUZE AT END OF CONTRACT PERIOD

costly and it could result in a warning tag whose folds were so set by the banding that the message printed on the tag would be hidden. To remedy this, the tag size was reduced and the material was changed from cloth to rigid vinyl.

To ensure that impact of a jettisoned bomb on normal terrain would not cause the arming pin to cut the arming wire, a crown was added to the arming pin (figure 2). The width of the collar retaining ring groove was also increased to provide a controlled stress flow path from the arming pin crown through the collar to the case. In this way the shear stress on both the arming wire and the collar retaining ring is zero for all conditions of impact.

Although the collar retaining ring is sufficiently stiff to remain lodged in its groove under all forseeable conditions, an added measure of safety was provided by staking the collar over the ring at the center of the "C" form.

At the request of the Air Force, the arming wire hole was rotated 90° with respect to the safety wire hole. This was done to facilitate the fuzing of bombs. A countersink form was added to both ends of the arming wire hole for the same reason.

Arming tests conducted on the first fuzes manufactured under the contract showed that for three out of five units tested, the arming time was up to 0.05 seconds less than the minimum allowable. Because the rotor spring must produce a rotor torque capable of overcoming 40 G for all positions of the rotor, the springs could not be reworked by changing their initial load condition or their free length. A new spring was designed and procured. The load-deflection curve of the new spring was less steep than that of the original spring, but the force level at the lower working limit remained unchanged. Energy output for the new spring was 16 percent less than for the old spring. This reduction brought the arming time for the fuze back within specified limits. All serialized fuzes discussed in this report contain the revised rotor spring.

A lot of twelve fuzes containing the new springs was made, and ten of these were checked on a centrifuge for 40-G arming. The test was witnessed by the project officer. All fuzes armed within the design limits. To check the normal abort characteristics of the fuze, one of the two remaining fuzes was dropped through a tube from a height of three feet onto concrete. The fuze did not abort. The failure was attributed to fixture performance, so the fixture was redesigned to provide unrestricted free fall from the drop height, and the second fuze was tested in this fixture. The fuze aborted correctly after three-foot fall. This demonstration was also witnessed by the project officer.

On the basis of the results from the twelve fuzes, the qualification lot of 304 fuzes was built. Design modifications which occurred after fabrication of the original qualification lot of fuzes will be discussed in the remainder of this section. A more complete description of the problems encountered, their solutions, and rescheduling of qualification tests to produce the maximum amount of useful information from the quantity of fuzes available, appears in section VI.

Normal function and normal abort were among the first tests conducted on fuzes from the qualification lot. Ten percent of the function test fuzes failed the test because they did not complete their arming cycle before ground impact. Analysis of these fuzes revealed that the high crimping pressure necessary to assure a watertight seal between the fuze case and adapter was causing deformation of the centerplate and the escapement housing. Deformed centerplates could degrade hammerweight operation, and deformed escapement housings would lead to an extension of arming time. If arming time was increased beyond that time required to complete the free fall, the fuze aborted instead of functioning. The problem was remedied by replacing the flat rubber seal washer with an O-ring. Thus a good seal was made at one-third the original crimping pressure.

When the normal abort test was performed on some new fuzes and on some which had been previously subjected to jolt and jumble tests, all but one of the fuzes armed instead of aborting. The problem was that the impact which was experienced after a three-foot drop, drove the firing pin into the portion of the rotor located between the end of the abort cavity and the detonator (figure 3). The zone in question occupied 30 percent of fuze arming time. To correct the difficulty, a design revision was necessary to provide a minimum time lapse between the "abort" and "full arm" rotor positions. If the required action was obtained by removing a number of teeth from one end of the rotor gear sector, then the arming time of the escapement would be out of specification. The only alternative available which would permit completion of the contract on schedule was to enlarge the abort cavity in the rotor so the cavity terminated as close to the detonator as possible. The required rework of figure 4 was performed on all deliverable fuzes (1,000 lot) plus ninety-nine additional fuzes which were allocated to function and abort tests. The ninety-nine fuzes also incorporated the new O-ring seal on the adapter end of the case. As a result of the rework 89 percent of the escapement time became available for abort action, compared with the original 70 percent. Since most of the escapements incorporating the revised rotor spring were timing out between 0.53 and 0.58 seconds, the acceptance tolerance limits for escapements were changed from the original "0.46 to 0.66 seconds" to "0.50 to 0.70 seconds." Under the new tolerance conditions, a normal abort is expected for all drop heights less than 3.2 feet, a seemingly innocuous decrease of 2.5 inches from the original requirement. If the Air Force decides in the future that it would be more desirable to increase the "100 percent abort" height above 3.2 feet, the moment of inertia of the escapement's verge weight could be increased in combination with removal of a maximum of two teeth from one end of the rotor gear sector. This change could be accomplished without altering the arming time limits, and would confine the "dead zone" in the escapement to the time required for the rotor to snap to the in-line position.

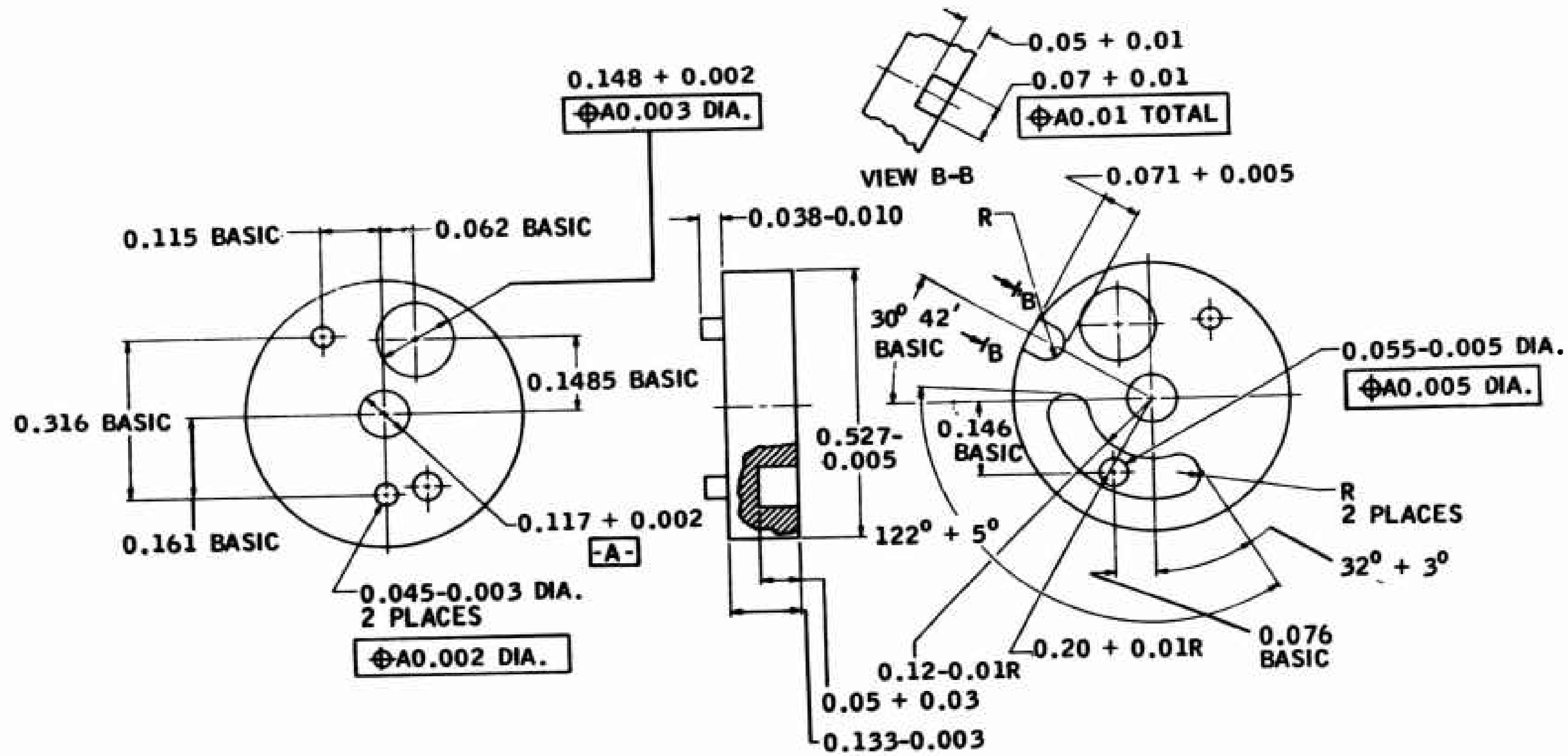


Figure 3 - ORIGINAL CONFIGURATION OF ROTOR

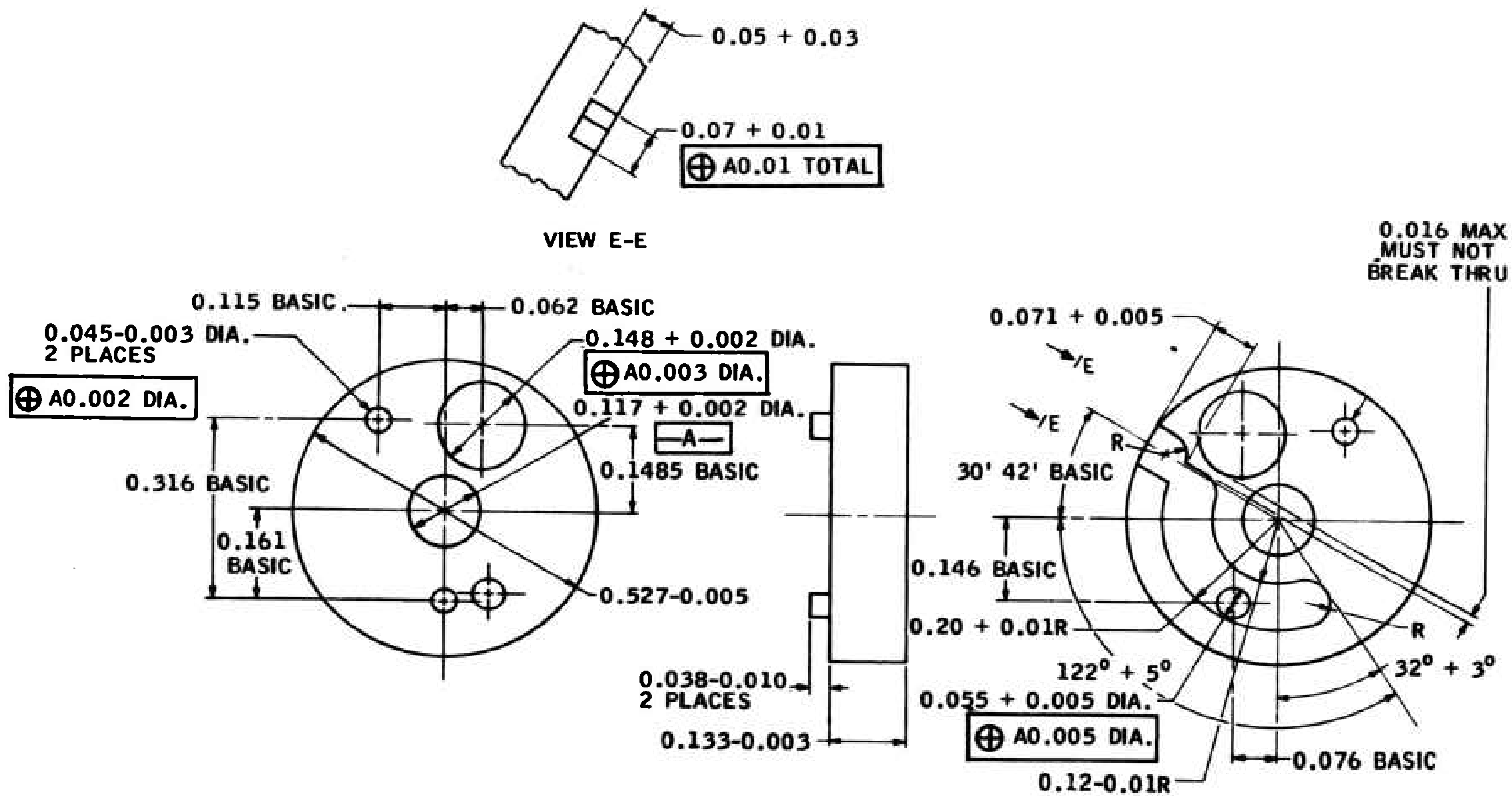


Figure 4 - ROTOR WITH REWORKED SECTION

SECTION V

QUALIFICATION TESTS

1. SERIALIZATION OF FUZES

Prior to final assembly of the qualification lot of FMU-68/B fuzes, twelve fuzes serialized 1A through 12A were made. Ten of these were checked for their arming capability at 40 G. When all armed properly and functioned when dropped from five-foot and two-foot heights, the remaining two were checked for abort as mentioned previously. The qualification lot which followed carried serial numbers below 310 and bore no suffix letter. These contained the original rotor configuration and the flat seal washer between the case and adapter.

Fifteen fuzes with a "B" suffix serial were manufactured to check the effect of replacing the flat seal washer between the case and adapter with an O-ring. All "B" units were confined to the function test.

Five fuzes with a "C" suffix were manufactured for testing of waterproofness. These fuzes used reject parts, with the exception of those parts that had a bearing on the test. The waterproofness test was used to check the new O-ring seal.

Ninety-nine fuzes with a "N" suffix included both the modified rotor and the new seal. These were used in 40-G arming tests, function tests, and abort tests.

Fuzes delivered to the Air Force under this contract bear serial numbers above 309 and contain all the modifications found necessary as a result of the qualification test program.

Table II details the construction and disposition of fuzes according to serial groupings. This table should be used as a quick reference when particular lots are mentioned in other parts of this report.

TABLE II

CONSTRUCTION AND DISPOSITION OF FUZES BY SERIAL NUMBER

SERIAL NUMBER	CONSTRUCTION	TESTS WHERE THESE FUZES WERE USED
1A-12A	REVISED ROTOR SPRING	40-G ARMING AND FUNCTION, NORMAL ABORT (2 VALID, 2 NOT VALID)
1-309	REVISED ROTOR SPRING	NORMAL ABORT (NOT VALID), FUNCTION (NOT VALID), TRANSPORTATION VIBRATION, 40-G ARMING SALT SPRAY, SENSITIVITY, ENVIRONMENTAL CYCLING, AIRCRAFT VIBRATION, 40-FOOT DROP, JOLT, JUMBLE, 5-FOOT DROP. NOTE: THIS GROUP IS TERMED THE "304 LOT" BECAUSE 304 FUZES WERE ORIGINALLY REQUIRED FOR ALL QUALIFICATION TESTS.
1B-15B	REVISED ROTOR SPRING, O-RING SEAL AT ADAPTER	FUNCTION
1C-5C	REVISED ROTOR SPRING, O-RING SEAL	WATERPROOFNESS
1N-99N	REVISED ROTOR AND ROTOR SPRING, O-RING SEAL	40-G ARMING, FUNCTION, NORMAL ABORT
310 AND ABOVE	REVISED ROTOR AND ROTOR SPRING, O-RING SEAL	LOT ACCEPTANCE*

* REMAINDER OF THIS LOT WAS DELIVERED TO THE AIR FORCE

2. GENERAL TEST PROCEDURE

The general test procedure consisted of test fixture preparations, testing, and failure analyses. In cases where test fuzes failed to perform correctly, failure analyses were made and revised hardware was provided for re-test. As a result of fuze failures and subsequent modifications, the proposed test plan of table III and figure 5 deviated as the tests progressed. Tests for which results could be construed as valid indications of fuze performance are arrayed in figure 6, which is an adjustment of figure 5 according to the dictates of existing conditions.

Although table III, which appeared in the proposal document, specifies that lead charges be in place for some of the tests, the charges were purposely omitted to facilitate analysis of failures with a minimum of hazard to operating personnel.

3. TEST RESULTS

The majority of qualification tests were conducted on the "304 lot" of fuzes, which represents the final fuze design except for the O-ring seal and the revised rotor. The O-ring seal, in addition to its primary function as a moisture barrier, affects fuze function and abort characteristics in that it avoids distortion of escapement housings. The rotor modification directly affects normal abort. For these reasons, fuzes from the "304 lot" were not used for scoring any of the primary function or primary abort tests. However, "304 lot" fuzes were used in many of the other qualification tests. Some results of function tests performed on "304 lot" fuzes are included as separate listings in the function test results because functionability after environment was the means of establishing fuze acceptability. A separate lot of 99 fuzes ("N" suffix fuzes) was used for all primary normal function and normal abort tests. The data obtained for these units supplants the data that made the seal and rotor revisions necessary.

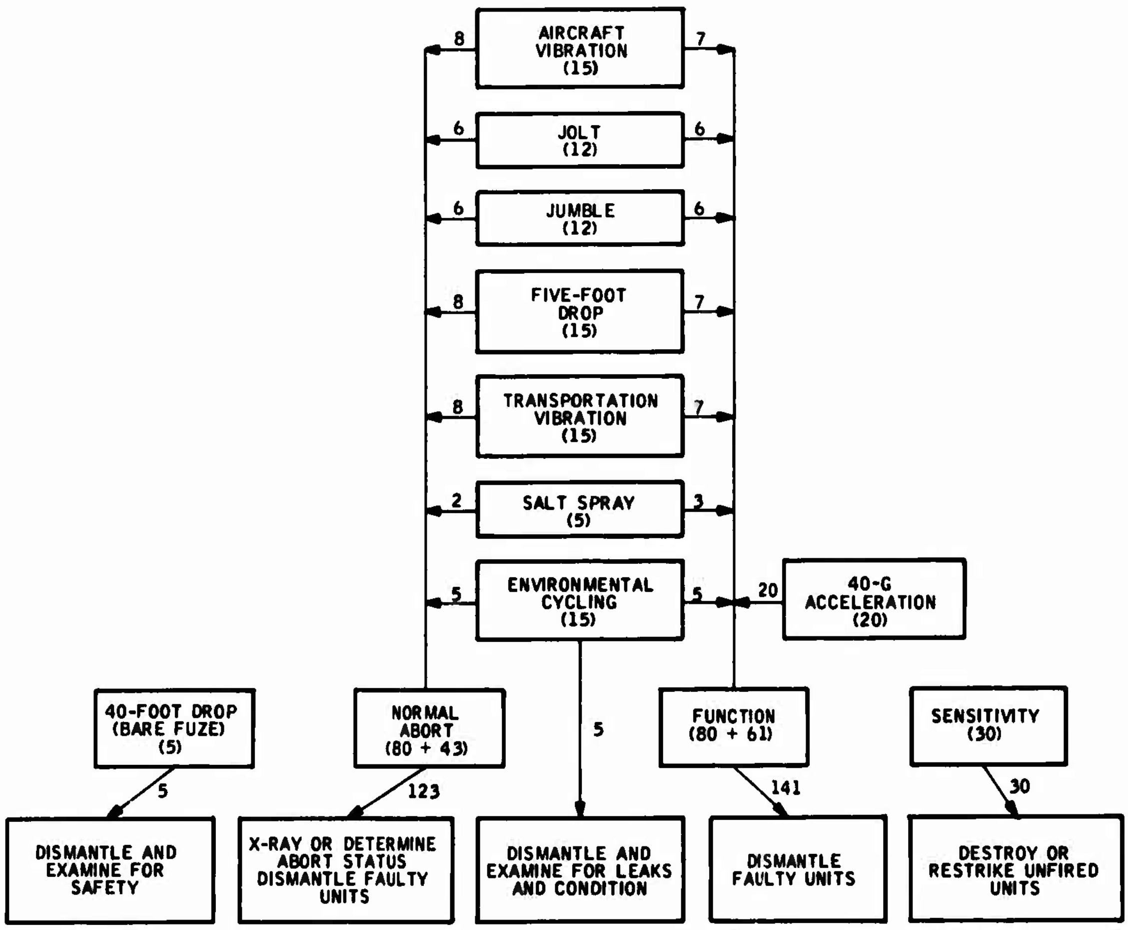
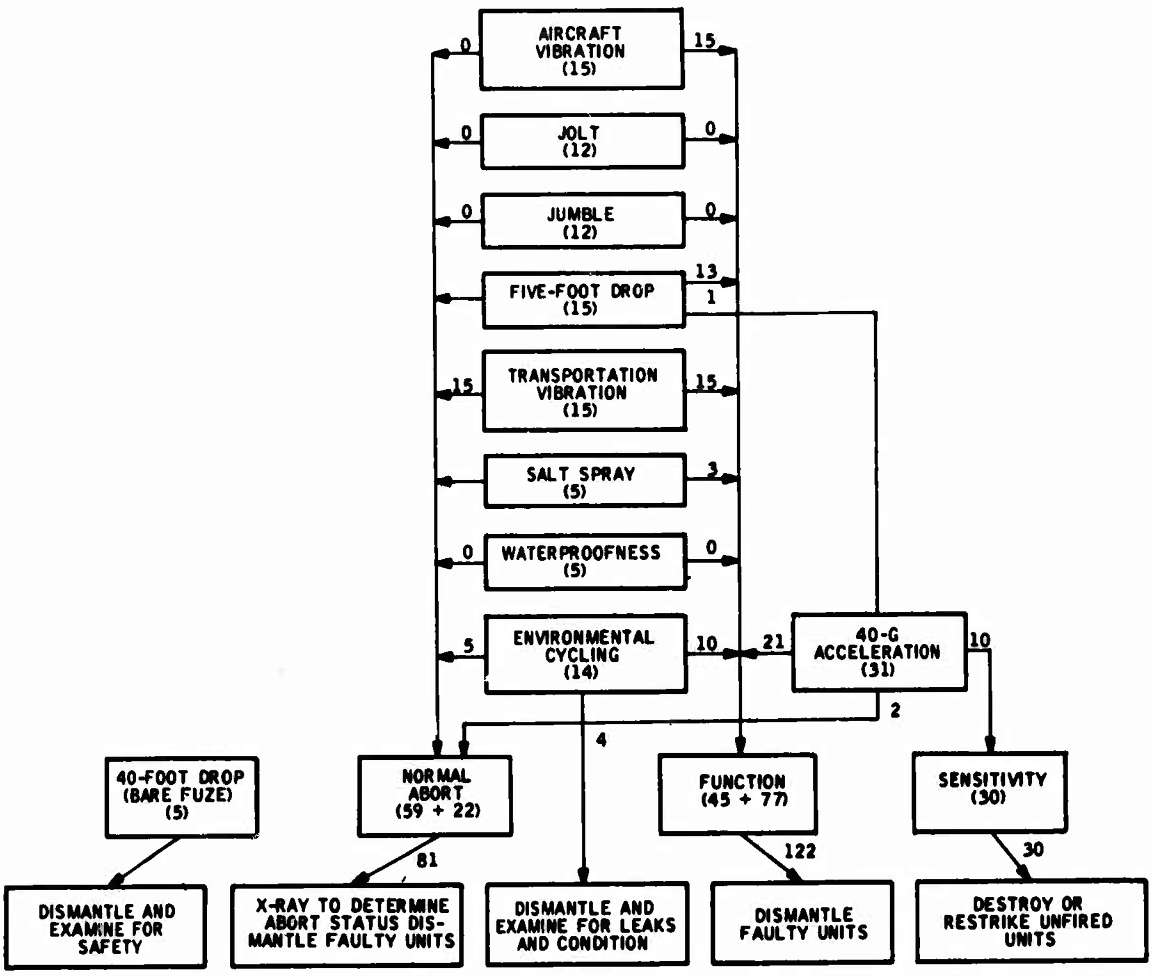


Figure 5 - PROPOSED FLOW DIAGRAM OF TESTING



NOTE: DISAGREEMENT IN NUMBERS OCCURS BECAUSE OF COMMENTS WHICH APPEAR IN TABLES IV AND V.

Figure 6 - FLOW DIAGRAM OF TESTING THOSE FMU-68/B FUZES FOR WHICH VALID TESTS WERE MADE

TABLE III
TEST RESULTS

TEST	UNITS DESIGNATED	TEST DESCRIPTION	RELIABILITY AT THE 0.90 CONFIDENCE LEVEL FOR	
			0 FAILURES	1 FAILURE
NORMAL ABORT	80	RANDOM ORIENTED DROP FROM LESS THAN 3.4 FEET AGAINST A STEEL PLATE OR CONCRETE. LEAD AND BURSTER CHARGES REMOVED.	0.971	0.951
FUNCTION	80	RANDOM ORIENTED DROP FROM BETWEEN 10 AND 16 FEET AGAINST A STEEL PLATE OR CONCRETE. CHOICE OF DROP HEIGHT DEPENDENT UPON ARMING PIN RESPONSE TIME. LEAD AND BURSTER CHARGES REMOVED.	0.971	0.951
SENSITIVITY	30	DETERMINE HEIGHT OF FALL AGAINST A STEEL PLATE FOR 50 PERCENT FUNCTION OF FUZES ORIENTED TO IMPACT ALONG THE LEAST SENSITIVE AXIS. ACCELEROMETER INSTRUMENTATION REQUIRED FOR G-TIME PULSE DESCRIPTION. LEAD AND BURSTER CHARGES REMOVED.	N/A*	N/A
40-G FUNCTION (NON-ABORT)	20	MOUNT FUZE ON ROTARY ACCELERATOR AND LOAD TO 40-G AXIAL ACCELERATION. PULL THE ARMING WIRE AND RECORD ARMING TIME VIA ACOUSTICAL TRANSDUCER. STOP THE ACCELERATOR AND DROP THE FUZE 5 FEET ONTO A HARD SURFACE. LEAD AND BURSTER CHARGES REMOVED.	0.885	0.810
40-FOOT DROP (BARE FUZE)	5	MIL-STD-302. RANDOM ORIENTED DROP OF SAFED FUZES FROM 40 FEET AGAINST CONCRETE OR STEEL. EXAMINE FOR RUGGEDNESS. DUMMY BURSTER CHARGES. NO LEAD CHARGE.	N/A	N/A
JOLT	12	MIL-STD-300 WITH INERT BURSTER. NO LEAD CHARGE.	0.82	N/A
JUMBLE	12	MIL-STD-301 WITH INERT BURSTER. NO LEAD CHARGE.	0.82	N/A
FIVE-FOOT DROP	15	MIL-STD-358 WITH INERT BURSTER. NO LEAD CHARGE.	0.84	N/A
TRANSPORTATION VIBRATION	15	MIL-STD-303 WITH INERT BURSTER. NO LEAD CHARGE.	0.84	N/A
AIRCRAFT VIBRATION	15	MIL-STD-810A METHOD 514, CLASS 1, MOUNTING A, FIGURE 514-1, CURVE C WITH INERT BURSTER. NO LEAD CHARGE.	0.84	N/A
ENVIRONMENTAL CYCLING	15	MIL-STD-304 WITH INERT BURSTER. LIVE LEADS AND DETONATORS.	0.84	N/A
SALT SPRAY	5	MIL-STD-810A, METHOD 509.0 WITH INERT BURSTER. NO LEAD CHARGE.	N/A	N/A
WATERPROOFNESS	5	MIL-STD-314. NO BURSTER CHARGE.	N/A	N/A

* NOT APPLICABLE

A collation of test results appears in table IV. It includes results from the qualification tests and from acceptance tests conducted on samples selected from the 1, 000 deliverable fuzes.

In some instances, static escapement times were recorded after the fuzes had been subjected to either a physical (jolt, jumble, etc.) or climatic (temperature, salt spray, etc.) environment. The fuzes were then intentionally functioned by dropping them on a hard surface. If the fuze functioned properly when dropped from a height of three feet, the result was construed as both "OK function" and "OK abort" since the energy required is of the same magnitude for both operating modes.

It should be noted that fuzes which were dropped on a hard surface to test their function or abort characteristics were not attached to a bomb-simulating weight. For this reason, a "good" fuze which happens to land on its arming pin may experience a shock pulse which is very much attenuated by the action of the arming pin spring. In these instances a "light" strike will be evident on the detonator after the fuze is dismantled. When both these conditions were found to exist for any one fuze, it was concluded that the fuze would have performed as intended if it had been assembled to a bomb.

Analysis of these results appears in section VII.

TABLE IV
COLLATED TEST RESULTS

QUALIFICATION TESTS	AMOUNT IN LOT	OK	FAILED	DISCUSSION
NORMAL ABORT	59	58	1	RESULTS ARE FOR REVISED FUZES ONLY
FUNCTION - FIRST TEST (ORIGINAL DESIGN)	51	46	5	NO. 233 COUNTED AS "OK FUNCTION". TEST WAS RE-RUN WITH REVISED FUZES. DO NOT SCORE.
FUNCTION - SECOND TEST (REVISED DESIGN)	45	45	0	NO. 2B, 3B, 4B COUNTED AS "OK FUNCTION".
TRANSPORTATION VIBRATION	15	15	0	MAY BE COUNTED AS "OK FUNCTION" OR "OK ABORT".
40-G ARM	30	29	1	10 ALLOCATED TO SENSITIVITY TEST AFTER ARMING.
FUNCTION AFTER 40 G	20	19	1	2 OF 2 (NO. 4A & 5A) CAN BE COUNTED AS "OK ABORT".
SALT SPRAY	5	5	0	
FUNCTION AFTER SALT SPRAY	3	3	0	CAN BE COUNTED AS "OK FUNCTION".
SENSITIVITY	30	NOT APPLICABLE		
WATERPROOFNESS	5	5	0	
TEMPERATURE AND HUMIDITY	14	14	0	10 OF 10 CAN BE COUNTED AS "OK FUNCTION". 5 OF 5 CAN BE COUNTED AS "OK ABORT".
AIRCRAFT VIBRATION	15	15	0	15 OF 15 CAN BE COUNTED AS "OK FUNCTION" TEST.
40-FOOT DROP	5	5	0	
JOLT	12	12	0	
FIVE-FOOT DROP	15	15		ALL SAFE AFTER DROP
	13	13	0	TIMED AND DROPPED 11 FEET (FUNCTION TEST).
	1	1	0	TIME AT 40 G AND DROPPED 11 FEET (40-G FUNCTION TEST).
LOT ACCEPTANCE TESTS				
TRANSPORTATION VIBRATION	22	22	0	MAY BE COUNTED AS "OK FUNCTION" TEST
NORMAL ABORT	10	10	0	

SECTION VI

TEST PROCEDURES AND DETAILS

1. INTRODUCTION

Detailed results of the tests described in the following paragraphs are contained in table V.

2. NORMAL ABORT

The first of two fuzes was held in a tube fixture at a height of three feet. The fuze was released by a lanyard which lead outside the test chamber. The fuze did not abort; it was believed that release from the fixture was not "clean". Oscillation of the fuze as it passed through the tube was considered to be sufficient to increase the time of fall beyond the escapement time of the fuze, producing function at impact instead of normal abort.

The tube fixture was replaced by a trap door fixture in which the fuze was oriented parallel to the floor and at a height of three feet. This new fixture was a five-sided box with the open side facing down. The fuze was retained between two ends of the box, one of which was hinged, and the hinged end was retained by a lanyard. The trap door fixture provided unrestrained fuze descent from the point of release. When the remaining fuze was dropped from the fixture, it aborted properly (figure 7). The qualification lot ("304 lot") of fuzes was built before testing was resumed.

Five fuzes from the "304 lot" which had already undergone other tests (3, jumble; 1, jolt; 1, five-foot drop) were tested for a normal abort and failed. Therefore, an attempt was made to abort six untested units. Five of these also failed. Examination of the dismanted units revealed that the firing pin was striking the rotor in the region between the abort cavity and the detonator, thereby causing neither an abort nor a function when the unit was intentionally dropped from three feet. Modification of the rotor design (see the report section pertaining to design modifications) was ordered and additional fuzes were built. Since the lot of qualification test units was

Table V - DETAILED TEST RESULTS

TYPE OF TEST	SERIAL NUMBER	ORIGIN	DROP HEIGHT (FT)	ABORT RESULT	COMMENTS
NORMAL ABORT (72)	6A	NEW	3.0	FUNCTION	THE TUBE-TYPE RELEASE FIXTURE SLOWED DOWN THE FREE-FALL. NEW RELEASE FIXTURE (FIGURE 7).
13 ORIGINAL STYLE PLUS 59 REVISED FUZES	12A	NEW	3.0	ABORT	
	74	JOLT	3.0	ARMED	FIRING PIN STABS ROTOR BETWEEN KIDNEY CAVITY AND DETONATOR. THESE ARE UNMODIFIED FUZES AND SHOULD NOT BE COUNTED IN SCORES.
	92	JUMBLE	3.0	ARMED	
	70	JUMBLE	3.0	ARMED	
	76	JUMBLE	3.0	ARMED	
	134	5-FOOT DROP	3.0	ARMED	
	210	NEW	3.0	ARMED	
	107	NEW	3.0	ARMED	
	116	NEW	3.0	ARMED	
	119	NEW	3.0	ABORT	
	125	NEW	3.0	ARMED	
	106	NEW	3.0	ARMED	
	41N	NEW	3.0	ABORT	ROTOR KIDNEY CAVITY EXTENDED ON ALL N NUMBERED UNITS.
	42N	NEW	3.0	ABORT	
	43N	NEW	3.0	ARMED	
	44N	NEW	3.0	ABORT	
	45N	NEW	3.0	ABORT	
	46N	NEW	3.0	ABORT	
	47N	NEW	3.0	ABORT	
	48N	NEW	3.0	ABORT	
	49N	NEW	3.0	ABORT	
	50N	NEW	3.0	ABORT	
	51N-99N	NEW	3.0	ALL UNITS ABORTED PROPERLY	

Table V - DETAILED TEST RESULTS
(continued)

TYPE OF TEST	SERIAL NUMBER	ORIGIN	DROP HEIGHT (FT)	FUNCTION RESULT	COMMENTS
FUNCTION (96)	137	NEW	11.5	FUNCTIONED	
	272				
	152				
	270				
	150			PARTIALLY ARMED	
	151			FUNCTIONED	
	243				
	237				
	231				
	225				
	226				
	227				
	228				
	229				
	230				
	232				
	233				
	234			ARMED	FAILED TO FIRE; LANDED ON ARMING PIN. INSUFFICIENT ENERGY ON IMPACT.
	235			FUNCTIONED	
	236				
	238				
	239				
	240				
	241				
	242				
	244				
	245				
	246				
	247				
	248				
	296				
	302			PARTIALLY ARMED	
	273			FUNCTIONED	
	274				
	275				
	276				
	277				
	278				
	279				
	280				

Table V - DETAILED TEST RESULTS
(continued)

TYPE OF TEST	SERIAL NUMBER	ORIGIN	STATIC ARM TIME (SEC)	DROP HEIGHT (FT)	FUNCTION RESULT	COMMENTS
FUNCTION (CONTINUED)	281	NEW		11.5	FUNCTIONED	
	282					
	283					
	284					
	285					
	286					
	287					
	288					
	289				PARTIALLY ARMED	
	290				FUNCTIONED	
	291				PARTIALLY ARMED	
ALL "B" NUMBERED UNITS CONTAIN AN O-RING SEAL AT THE ADAPTER	1B	NEW		11.5	FUNCTIONED	
	2B				ARMED	FUZE LANDED ON ARMING PIN CAUSING INSUFFICIENT ENERGY TRANSFER TO FIRE THE DETONATOR.
	3B				ARMED	
	4B				ARMED	
	5B			15	FUNCTIONED	LANDED ON ANOTHER FUZE CAUSING INSUFFICIENT ENERGY TRANSFER TO FIRE THE DETONATOR.
	6B					
	7B					
	8B					
	9B					
	10B					
	11B					
	12B					
	13B					
	14B					
	15B					
ALL "N" NUMBERED UNITS CONTAIN NEW O-RING SEAL AT THE ADAPTER AND MODIFIED ROTOR.	1N	NEW	0.54	11.0	FUNCTIONED	
	2N		0.55			
	3N		UNK.*			
	4N		0.54			
	5N		0.55			
	16N		0.54			
	17N		0.55			
	18N		0.54			
	19N		0.56			
	20N		0.51			
	21N		0.54			
	22N		0.55			
	23N		0.54			
	24N		0.54			

* UNKNOWN

Table V - DETAILED TEST RESULTS (continued)

TYPE OF TEST	SERIAL NUMBER	ORIGIN	STATIC ARM TIME (SEC)	DROP HEIGHT (FT)	FUNCTION RESULT	COMMENTS
FUNCTION (CONTINUED)						
	25N	NEW	0.59	11.0	FUNCTIONED	
	26N		0.52			
	27N		0.53			
	28N		0.51			
	29N		0.56			
	30N		0.52			
	31N		0.60			
	32N		0.54			
	33N		0.56			
	34N		0.54			
	35N		0.54			
	36N		0.53			
	37N		0.58			
	38N		0.57			
	39N		0.55			
	40N		0.55			
TRANSPORTATION VIBRATION (15)		CONDITION AFTER TEST				
	95	SAFE	0.57	3.0	FUNCTIONED	
	95		0.62			
	96		0.52			
	102		0.54			
	104		0.53			
	110		0.53			
	113		0.55			
	121		0.53			
	138		0.53			
	139		0.55			
	140		0.53			
	144		0.53			
	145		0.53			
	90		UNK.*			
	148		UNK.			

* UNKNOWN

Table V - DETAILED TEST RESULTS
(continued)

TYPE OF TEST	SERIAL NUMBER	ARMING TIME (SEC)	DROP HEIGHT (FT)	FUNCTION RESULTS	COMMENTS
40-G ARMING AND FUNCTION (20 + 10 FOR SENSITIVITY)	1A	0.530	5.0	YES	
	2A	0.567	5.0	YES	
	3A	0.600	5.0	YES	
	4A	0.638	2.0	YES	
	5A	0.554	2.0	YES	
	7A	0.576	5.0	YES	
	8A	0.608	5.0	YES	
	9A	0.610	5.0	YES	
	10A	0.612	5.0	YES	
	11A	0.561	5.0	YES	
	33	0.620			THE OSCILLOGRAPH TRACE WAS DIFFICULT TO INTERPRET. THEREFORE THESE TEN ARMING TIMES ARE AN AVERAGE OF WHAT WAS THOUGHT TO BE THE MAXIMUM AND MINIMUM TIMES ON EACH FUZE.
	34	0.599			
	38	0.557			
	39	0.528			
	40	0.531	FOR SENSITIVITY TEST		
	41	0.617			
	42	0.561			
	44	0.605			
	45	0.528			
	48	0.589			
	6N	0.64	11.0	YES	ALL "N" NUMBERED UNITS CONTAIN NEW O-RING SEAL AND MODIFIED ROTOR.
	7N	0.64	11.0	YES	
	8N	0.57	11.0	YES	
	9N	0.68	11.0	YES	
	10N	0.54	11.0	YES	
	11N	0.41			NOT DROPPED. FUZE ABORTED FOR UNKNOWN REASON DURING TIMEOUT.
	12N	0.56	11.0	YES	
	13N	0.70	11.0	YES	
	14N	0.61	11.0	YES	
	15N	0.57	11.0	YES	
SALT SPRAY (5)	87	UNK.*	11.0	YES	
	98	0.51	11.0	YES	
	103	0.54	CUT OPEN		NO CORROSION OR MOISTURE.
	109	0.60	11.0	YES	
	111	0.55	CUT OPEN		NO CORROSION OR MOISTURE.

* UNKNOWN

Table V - DETAILED TEST RESULTS
(continued)

TYPE OF TEST	SERIAL NUMBER	POSITION	DROP HEIGHT (IN.)	FUNCTION	COMMENTS
SENSITIVITY (30)	43	HORIZONTAL	9.5	NO	BRUCETON METHOD USED TO DETERMINE 50% FIRE PT. REFER TO FIGURE 12.
	50		19.0	YES	
	33		13.5	NO	
	39		16.5	YES	
	34		14.5	YES	
	42		14.0	YES	
	301		14.5	YES	
	300		14.0	YES	
	299		13.5	YES	
	309		13.0	YES	
	46	NOSE DOWN	14.0	YES	
	32		7.0	NO	
	47		11.0	NO	BRUCETON METHOD REFER TO FIGURE 12.
	38		13.0	NO	
	41		13.5	YES	
	51		13.25	YES	
	306		13.0	NO	
	118		12.5	NO	
	115		13.5	YES	
	124		14.0	NO	
	48	NOSE UP	14.0	YES	
	49		7.0	NO	
	44		10.0	YES	
	40		8.0	YES	BRUCETON METHOD REFER TO FIGURE 12.
	36		7.5	YES	
	45		7.25	NO	
	123		7.0	NO	
	114		7.5	NO	
	105		7.5	NO	
	117		8.0	NO	
		CONDITION			
WATERPROOFNESS (5)	1C	NO LEAKAGE			
	2C				
	3C				
	4C				
	5C				

Table V - DETAILED TEST RESULTS (continued)

TYPE OF TEST	SERIAL NUMBER	CONDITION AFTER TEST	STATIC ARMING TIME (SEC)	DROP HEIGHT (FT)	FUNCTION RESULTS	COMMENTS
ENVIRONMENTAL (TEMPERATURE-HUMIDITY CYCLING) (14)	6	SEE FIGURE 13	0.62	11.0	FUNCTIONED	REMOVED AFTER 16 DAYS
	9		0.62	11.0		
	14		0.53	11.0		
	18		0.60	11.0		
	23		0.58	11.0		
	1	GOOD	0.61	3.0		
	7		0.56	3.0		
	12		0.56	3.0		
	16		0.53	3.0		REMOVED AFTER 28 DAYS
	24		0.58	3.0		
	3		0.55		CUT OPEN	
	8		0.58		CUT OPEN	NO LEAKAGE FOUND
	10		0.52		CUT OPEN	
	17		0.51		CUT OPEN	
AIRCRAFT VIBRATION MIL-STD-810A (15)	62	SAFE	0.52	11.0	FUNCTIONED	
	81		0.55			
	83		0.55			
	126		0.53			
	128		0.52			
	131		0.55			
	133		0.56			
	127		0.54			
	141		0.55			
	142		0.53			
	143		0.66			
	146		0.50			
	147		UNK.*			RECORDER FAILED, BUT DURATION WAS AUDIBLY CORRECT
	182		0.54			
	186		0.55			
40-FOOT DROP (5)	89	SAFE	0.57		DUD	
	91		0.56		FUNCTION	
	100		N/A**		NONE PARTIAL ARM	
	101		0.56		FUNCTION	
	108		STUCK		NONE	WON'T ARM

* UNKNOWN
** NOT APPLICABLE

Table V - DETAILED TEST RESULTS (concluded)

TYPE OF TEST	SERIAL NUMBER	POSITION	CONDITION AFTER TEST	STATIC ARMING TIME (SEC)	DROP HEIGHT (FT)	FUNCTION RESULTS	COMMENTS
JOLT (12)	72		SAFE	0.56	11.0	OK	
	65			0.54		OK	
	79			0.58		OK	
	78			0.48		OK	
	71			0.38			PARTIAL ARM CAME LOOSE IN FIXTURE PARTIAL ARM
	60			NONE			
	73			0.55	11.0	OK	
	68			0.62		OK	
	61			0.54		OK	
	67			0.56		OK	
	74			USED IN ABORT TEST			
	95			0.53	11.0	OK	
JUMBLE (12)	77		SAFE	0.53	11.0	OK	
	63			0.56			
	58			0.52			
	64			0.57			
	52			UNK.*			
	75			0.54			
	69			0.57			
	92			USED IN ABORT TEST			
	59			0.48	11.0	INCOMPLETE ARMING	
	66			0.55	11.0	OK	
	70			USED IN ABORT TEST			
	76			USED IN ABORT TEST			
5-FOOT DROP (15)	130	NOSE DOWN	SAFE	0.52	11.0	FUNCTION	
	135	NOSE DOWN		0.52			
	120	NOSE DOWN		0.55			
	132	NOSE UP		0.55			
	149			0.52			
	134			USED IN ABORT TEST			
	129	HORIZONTAL		0.56	11.0	FUNCTION	
	80			0.56			
	97			0.57			
	99	45° NOSE DOWN		0.55			
	15			0.58			
	94			0.54			
	88	45° NOSE UP		0.56			
	112			0.54			
	122			0.70			THIS UNIT WAS ARMED AT 40-G BEFORE 11-FOOT DROP

* UNKNOWN

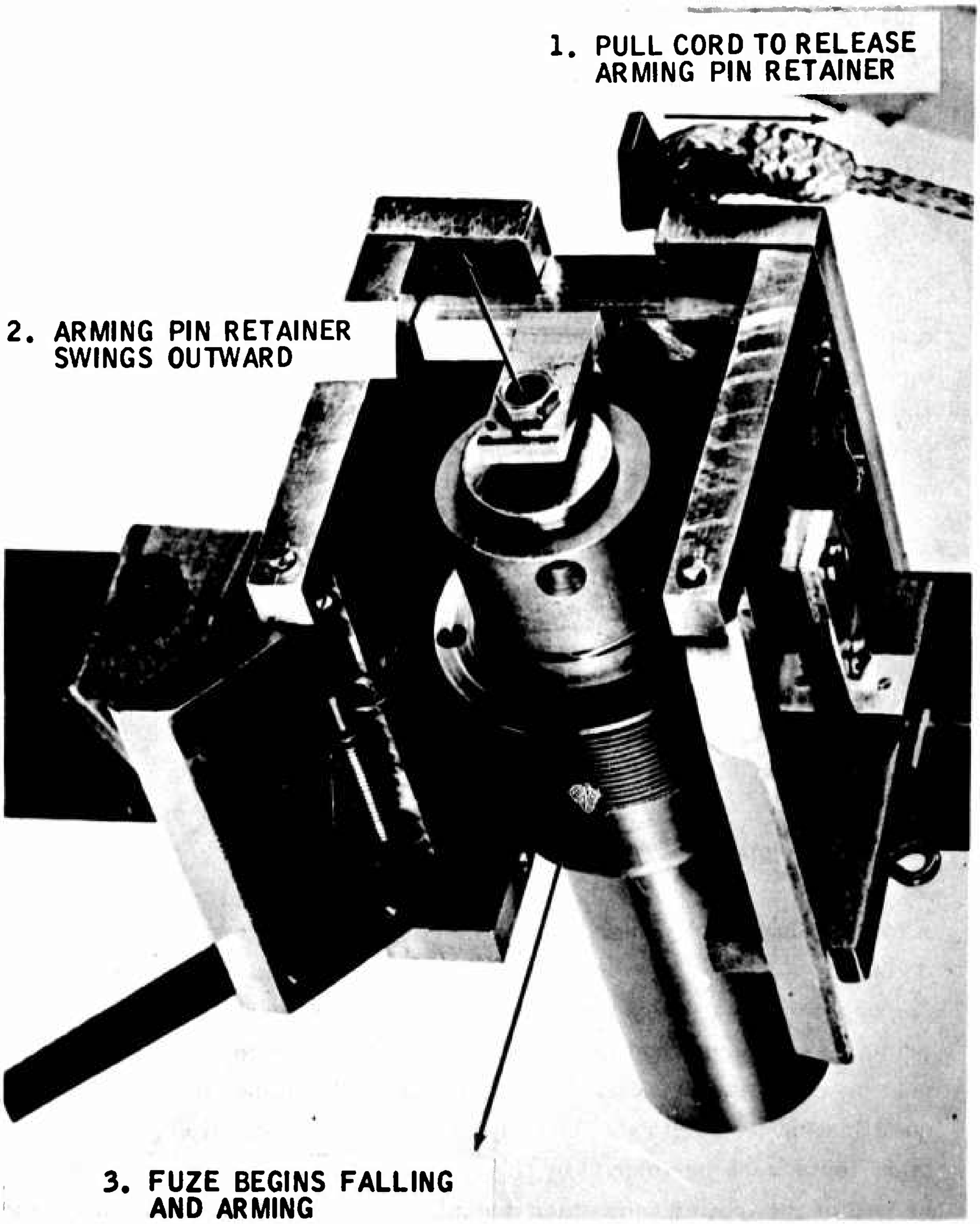


Figure 7 - TEST FIXTURE FOR DROPPING FUZES

already assembled, the normal abort portion of other tests conducted on "304 lot" fuzes was replaced by a test in which each fuze was manually armed and timed. The fuzes then were functioned by a drop from a three-foot height. Since the same magnitude of energy is required to function as to abort a fuze, this test may be construed to be an abort test, provided that fuzes with redesigned rotors abort properly when dropped unarmed from 3 feet. The rotor design is also discussed in section IV. 2.

Fifty-nine new fuzes (N suffix serial numbers) with modified rotors were tested in the drop test fixture from a three-foot height. Fifty-eight of these aborted properly. The other unit armed when recovered but had not fired. X-ray and dismantling of the fuze did not reveal a reason for the failure.

3. FUNCTION TEST

Fifty-one fuzes from the "304 lot" were dropped 11.5 feet onto concrete, using the fixture shown in figure 7 which simultaneously released the arming pin and initiated the fuze drop. Six fuzes failed to function. Upon recovery, five were aborted and one was fully armed but had not fired. The latter unit had landed on the arming pin which probably absorbed enough energy through the arming pin spring to prevent proper functioning of the centerplate assembly.

After thorough X-ray analysis, disassembly, and inspection of the aborted units, the difficulty was traced to the excessive pressure which was applied during crimping of the adapter to the fuze housing. The gasket seal at the crimp was changed from a flat rubber ring to an O-ring, permitting a 66 percent reduction in the crimping pressure. Since the entire lot of qualification test units was already assembled, the function portion of the other tests were performed by first arming each fuze while obtaining a record of its arming time, then dropping the fuze a known distance onto concrete. A microphone pickup and oscillograph recorder were used to record arming time data. The change in sealing method is also discussed in section IV. 2.

Four fuzes containing the new seal ("B" suffix serials) were released from the drop fixture to free-fall 11.5 feet while the escapement was running. One unit functioned. The other three armed but failed to fire. Two units landed on their arming pin springs; the third glanced off an expended fuze which was lying in the impact area. The remaining eleven "B" serial units were tested from 15 feet. All units functioned properly.

Thirty redesigned fuzes ("N" serial) were timed and dropped 11 feet onto concrete. All functioned properly. The arming pins and arming pin springs were removed from the fuzes before they were dropped--a precaution which eliminated impact on the arming pin as a factor affecting fuze function.

4. TRANSPORTATION VIBRATION TEST

Fifteen fuzes of the "304 lot" were vibrated per MIL-STD-303. All units were X-rayed after they were removed from the shipping container used for the first vibration cycle. Since no peculiarities were noted on the X-rays, the vibration schedule was continued with the same 15 units secured individually in a rigid fixture. All units were full-safe after test. After vibration, all of the units were manually armed and functioned by a three-foot drop.

5. 40-G ACCELERATION TEST

Forty fuzes were subjected to a 40-G steady state axial dynamic force in a centrifuge. The output-end of the fuze pointed toward the center of rotation. The arming pin was released remotely while a microphone pick-up transmitted the fuze arming vibrations to an oscillograph recorder (figures 8 and 9).

A group of ten "A" serial fuzes was armed at 40 Gs while their arming times were recoreded. All ten units were functioned by dropping them on a concrete floor; eight units were dropped at five feet, two at two feet. Because twenty total units were required for the 40-G acceleration test, a

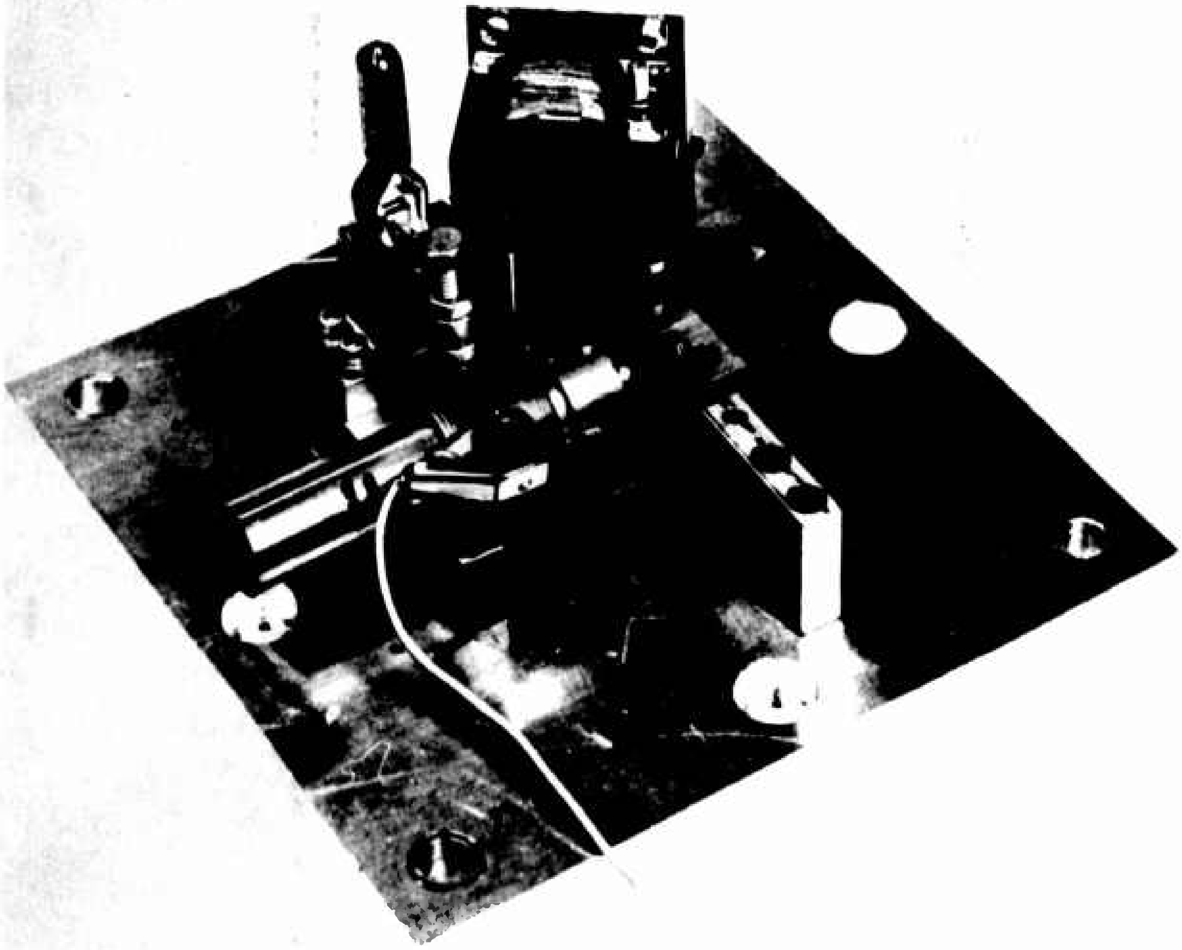


Figure 8 - 40-G ARMING FIXTURE SHOWING FMU-68/B FUZE BEFORE ARMING PIN RELEASE

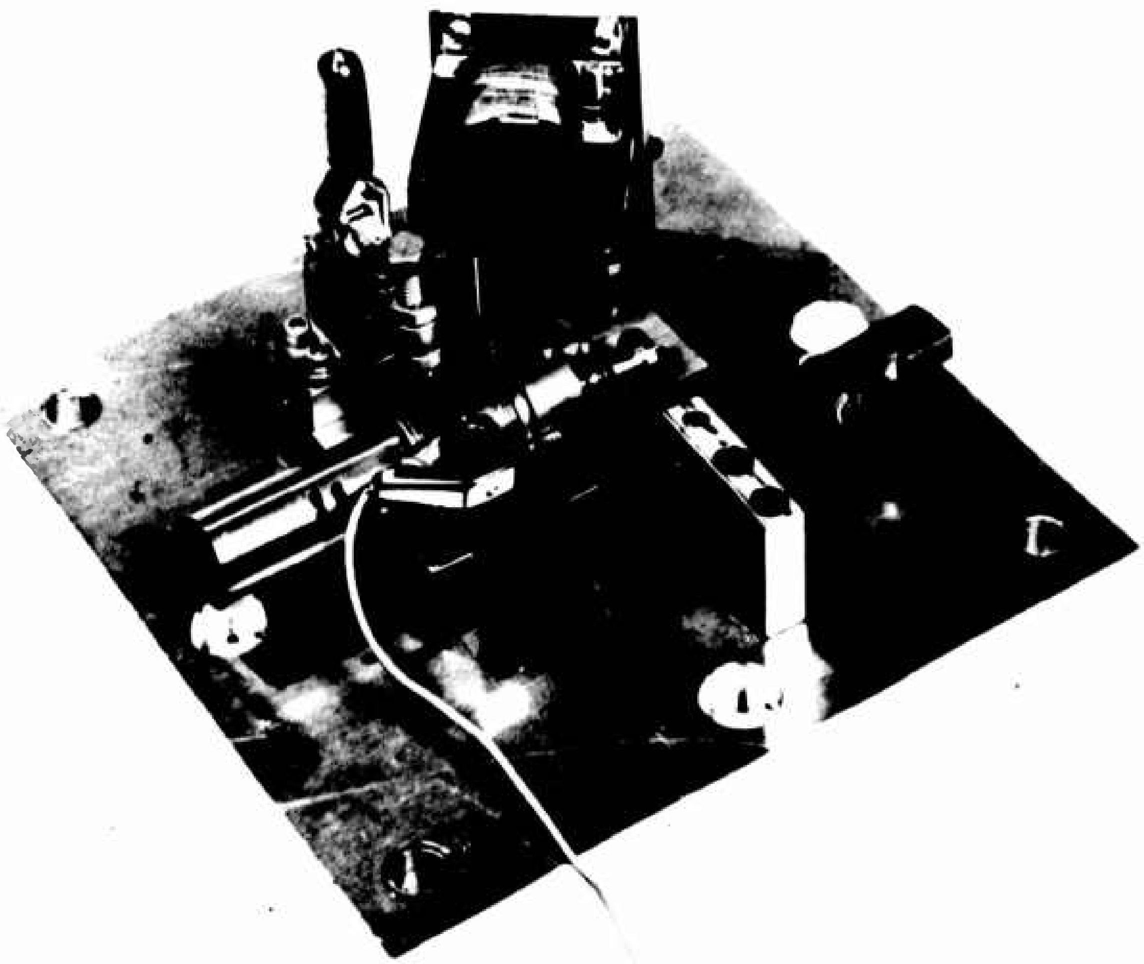


Figure 9 - 40-G ARMING FIXTURE SHOWING FMU-68/B FUZE AFTER ARMING PIN RELEASE

second group of ten "304 lot" fuzes was armed, but data for these fuzes was nullified because of a later discovery that electrical grounding of the instrumentation was faulty. A third set of ten units, chosen from the sensitivity test group, was armed at 40 Gs to obtain the necessary data. After making the O-ring and rotor changes, a fourth group of ten "N" serial fuzes was armed at 40 Gs and functioned by dropping them 11 feet onto concrete. Nine of the ten armed properly; all of the nine functioned properly. The one fuze that failed during 40-G arming was in the abort condition after spin-up. The reason for the failure could not be established from X-rays or from inspection of the dismantled fuze.

6. SALT SPRAY TEST

Five fuzes from the "304 lot" were subjected to salt spray as per MIL-STD-810A, method 509.1 (refer to figure 10). After completion of the test, all five fuzes were manually armed and the arming times were monitored. Three fuzes were then dropped 11 feet for a function test; all three functioned properly. The remaining two were cut open to inspect for leakage and/or corrosion. No leakage or corrosion was evident except on the arming pin safety wire.

7. SENSITIVITY TEST

Three groups of ten fuzes each from the "304 lot" were tested in one of three orientations: nose up, nose down, and horizontal. Ten of the thirty were armed during the 40-G test; the remaining 20 units were armed manually prior to releasing the pendulum (figure 11). The Bruceton method was used to determine the 50 percent function probability point for the first six units in each orientation. The remaining four fuzes in each group were tested at drop heights near the 50 percent function probability points, while the G-time pulse was monitored via a transducer and oscilloscope. However, after the test was complete, an analysis showed that since the test fixture was not secured, numerous other pulses appeared on the scope, preventing reliable data reduction. No further attempt was made to obtain a G-time shock pulse. The approximate 50

Figure 10 - FMU-68/B FUZES AFTER SALT SPRAY TEST

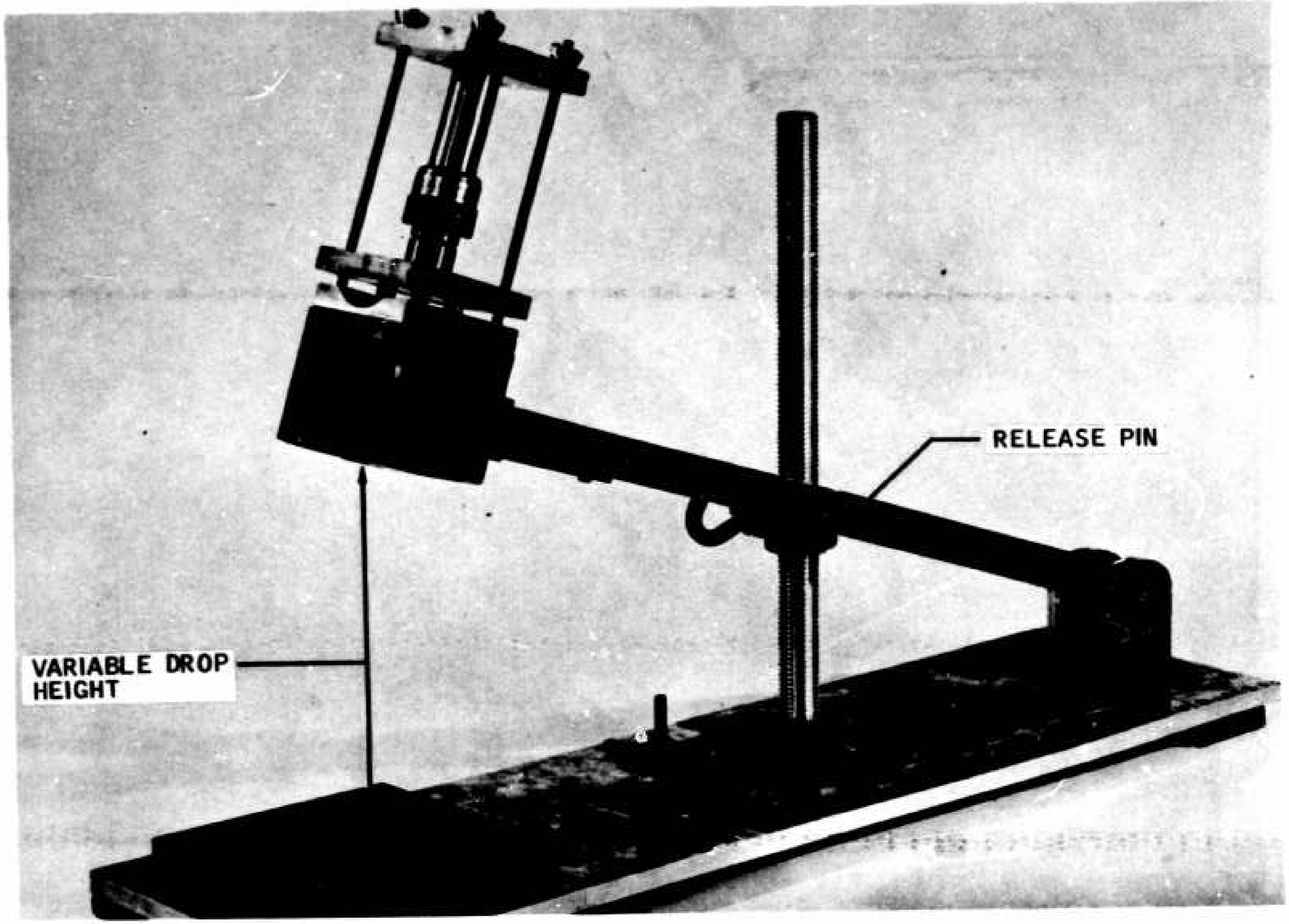


Figure 11 - SENSITIVITY TEST FIXTURE

percent function probability points for the nose up, nose down, and horizontal fuze impact orientations were 7.3 inches, 13.2 inches, and 13.7 inches, respectively (figure 12).

8. WATERPROOFNESS TEST

Five "C" serial fuzes with an O-ring gasket crimped between the adapter and fuze housing were tested per MIL-STD-314. Three of the fuzes were manually armed and the arming times recorded. All five units were cut open for inspection. No leakage was detected.

9. ENVIRONMENTAL CYCLING

Fourteen fuzes from the "304 lot" were subjected to a temperature-humidity cycle per MIL-STD-304. After 16 days, five units were removed from the chamber (figure 13), manually armed, and dropped 11 feet for a function test. All five fuzes functioned properly. After 28 days, the remaining nine units were removed and manually armed while the arming times were monitored. Five units were functioned from a three-foot drop height. All five fuzes functioned properly. The remaining four fuzes were cut open and inspected. No leakage or corrosion was detected.

10. AIRCRAFT VIBRATION TEST

Fifteen fuzes from the "304 lot" were vibrated as per MIL-STD-310A, method 514.1C, class 1, mounting A, test curve 514.1C. The vibrated units were manually armed and functioned after they dropped 11 feet onto concrete. The arming times were monitored by an oscillograph recorder. All the fuzes functioned properly.

11. FORTY-FOOT DROP TEST

Five safetied fuzes experienced a forty-foot free-fall drop onto concrete and/or steel as per MIL-STD-302. All units were safe to handle after test.

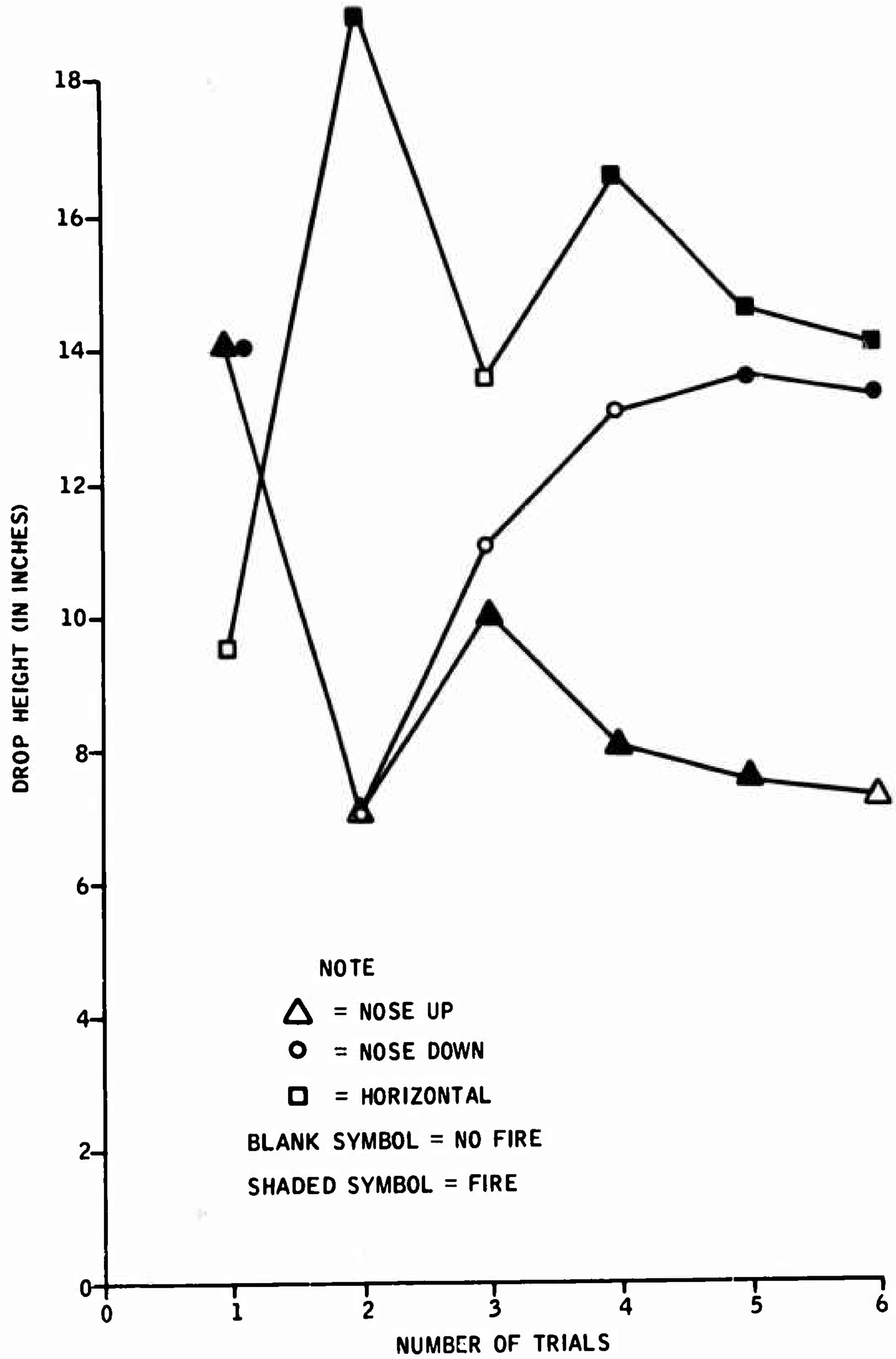


Figure 12 - BRUCETON ANALYSIS OF FUZE DROP HEIGHT TO DETERMINE 50 PERCENT FUNCTION PROBABILITY POINT

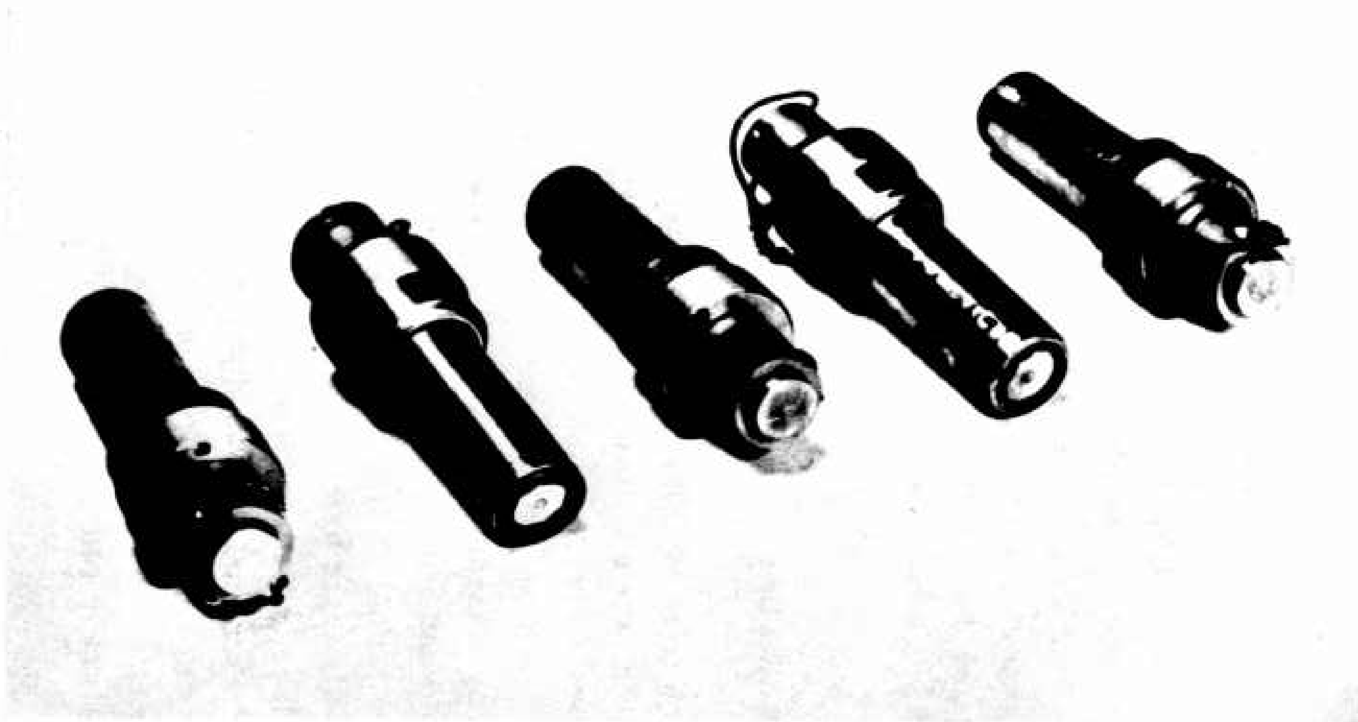


Figure 13 - FMU-68/B FUZES AFTER 16 DAYS OF TEMPERATURE-HUMIDITY CYCLING

An attempt was made to function the units after monitoring the static arming times. Two of the fuzes functioned properly. Function is not required after forty-foot drop testing.

12. JOLT TEST

Twelve fuzes from the "304 lot" were tested per MIL-STD-300. All units were safe to handle after the test. One of the units (no. 74) was allocated to the normal abort test before the rotor problem was uncovered. Another fuze (no. 60) shook loose in the fixture and became damaged at the crimp. A hammerweight hinge-pin also came loose in the fuze. The remaining fuzes were manually armed. One unit (no. 71) partially armed and stuck. X-ray revealed that a ball had fallen out of the push-pin. The arming times for all units were recorded, and nine of the twelve fuzes functioned properly. Function is not required after jolt testing.

13. JUMBLE TEST

Twelve fuzes from the "304 lot" were tested per MIL-STD-301. All fuzes were safe to handle after test. Nine of the twelve fuzes were then manually armed while the arming times were recorded. The nine armed fuzes were dropped 11 feet for a function test. Eight of the nine fuzes functioned properly. X-ray analysis revealed that the failure (no. 59) occurred because the firing pin and centerplate assembly were not properly indexed to the fuze housing. Consequently, the firing pin missed the detonator. Three fuzes were allocated to the normal abort test before the rotor problem was uncovered (see under normal abort test in table V). Because these fuzes contained the original rotor configuration, all three units failed to abort. Function is not required after jumble testing.

14. FIVE-FOOT DROP TEST

Five groups of three fuzes each from the "304 lot" were dropped per MIL-STD-358 onto a steel pad (figure 14). All units were full-safe after drop test. Fourteen of the tested fuzes were manually armed and dropped 11

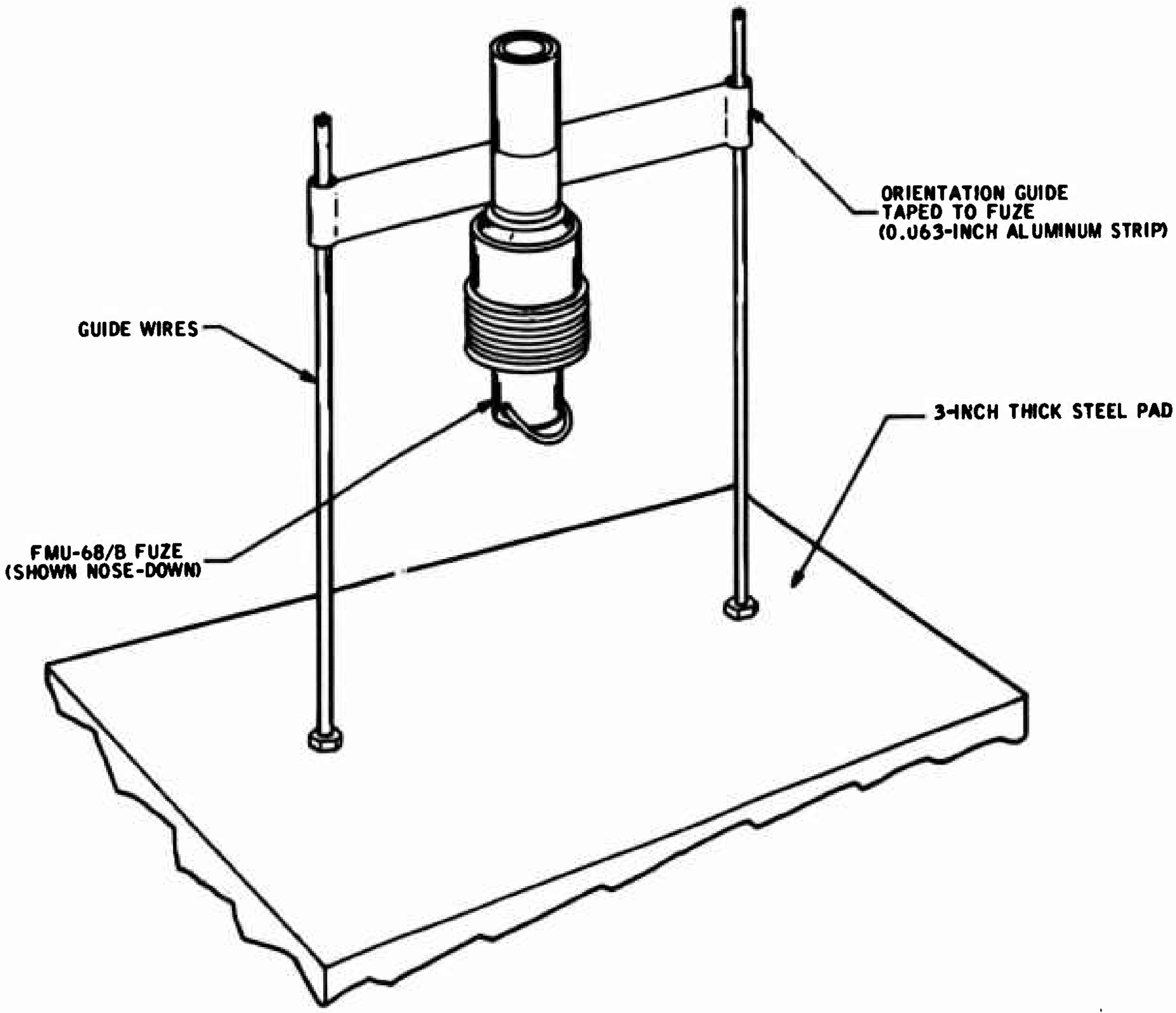


Figure 14 - FIVE-FOOT DROP TEST APPARATUS

feet to function on concrete. Arming times were recorded, and all 14 fuzes functioned properly. One unit was allocated to the normal abort test at three feet before the rotor problem was uncovered; that fuze failed to abort.

15. LOT ACCEPTANCE TESTS

To prove the acceptability of fuzes delivered under this contract, 32 fuzes were selected from those which were to be shipped. Twenty-two of these fuzes were vibrated per MIL-STD-303, and then subjected to the normal function test (an 11-foot fall from the fixture of figure 7 onto a concrete floor). The one malfunction observed is known to have landed on its arming pin. X-ray analysis showed no irregularity, and disassembly revealed a single light strike of the firing pin on the detonator. Consequently, the unit should not be scored as a failure.

Ten fuzes were dropped from three feet onto the concrete, using the fixture of figure 7. All fuzes aborted properly. Detailed results of lot acceptance tests appear in table VI.

TABLE VI

LOT ACCEPTANCE TEST RESULTS

I. FUNCTION TEST AFTER VIBRATION PER MIL-STD-303 (22 FUZES):

FUZE NUMBER	CONDITION AFTER VIBRATION FULL-SAFE	FUNCTION AT 11 FEET
876	FULL-SAFE	YES
951	FULL-SAFE	YES
956	FULL-SAFE	YES
919	FULL-SAFE	YES
1010	FULL-SAFE	YES
1015	FULL-SAFE	YES
2004	FULL-SAFE	YES
2017	FULL-SAFE	YES
2076	FULL-SAFE	YES
3016	FULL-SAFE	YES
3017	FULL-SAFE	YES
3019	FULL-SAFE	YES
3088	FULL-SAFE	YES
3105	FULL-SAFE	YES
3141	FULL-SAFE	YES
3157	FULL-SAFE	YES
3172	FULL-SAFE	YES
3185	FULL-SAFE	NO, FULL ARMED, LANDED ON ARMING PIN. CONSIDERED OK FUNCTION.
3189	FULL-SAFE	YES
3198	FULL-SAFE	YES
3244	FULL-SAFE	YES
3325	FULL-SAFE	YES

II.. ABORT TEST (10 FUZES):

FUZE NUMBER	CONDITION AFTER DROP FROM THREE FEET
830	ABORTED
1049	ABORTED
1327	ABORTED
1641	ABORTED
1906	ABORTED
1982	ABORTED
2062	ABORTED
2136	ABORTED
2472	ABORTED
2964	ABORTED

SECTION VII

DISCUSSION OF RESULTS

Table VII was constructed from the listings and remarks contained in tables IV, V, and VI. Because reliability at the 0. 90 confidence level has little meaning for small sample sizes, entries in table VII were limited to those lots whose valid data were based on at least 20 units. For data on sample sizes of less than 20 units, refer to tables IV, V, and VI. The information contained in tables VII does not include resutls of tests which triggered a redesign of the fuze, but does include the interpretations of fuze function noted in the source tables (IV, V, and VI).

In no instance did the revised fuze design produce more than one validated malfunction in a particular test. Reliability at the 0. 90 confidence level for normal abort and normal function tests (the two tests which determine the basic properties of the fuze) is 0. 956 and 0. 973, respectively. The basic tests under these two headings show reliability of 0. 943 for normal abort and 0. 95 for function, also at the 0. 90 confidence level. A target figure of 0. 95 reliability at the 0. 90 confidence level was given in the proposal document which led to this contract.

TABLE VII

INTERPRETATION OF TEST RESULTS

TEST	APPLICABLE QUANTITY TESTED	SOURCE TEST	PASSED	RELIABILITY AT THE 0.90 CONFIDENCE LEVEL
NORMAL ABORT	59*	NORMAL ABORT	58*	0.934
	15	TRANSPORTATION VIBRATION	15	
	2	40-G FUNCTION	2	0.943
	5	TEMPERATURE AND HUMIDITY	5	
	10	LOT ACCEPTANCE	10	
	91		90	0.956
FUNCTION	45*	FUNCTION (2ND TEST)	45*	0.948
	15	TRANSPORTATION VIBRATION	15	
	20	40-G FUNCTION	19	
	3	SALT SPRAY	3	
	10	TEMPERATURE AND HUMIDITY	10	0.965
	15	AIRCRAFT VIBRATION	15	
	13	FIVE-FOOT DROP	13	
	1	FIVE-FOOT DROP	1	
	22	LOT ACCEPTANCE	22	0.890
	144		143	0.973
40-G ARM	30*	40-G ARM	29*	0.870
	1	FIVE-FOOT DROP	1	
	31		30	0.870
40-G FUNCTION	20*	40-G FUNCTION	19*	0.810
TRANSPORTATION VIBRATION	15*	TRANSPORTATION VIBRATION	15*	0.850
	22*	LOT ACCEPTANCE	22*	0.890
	37		37	0.937

* DENOTES QUANTITIES FROM THE BASIC TEST, USING NEW FUZES.

SECTION VIII

CONCLUSIONS

The following are the conclusions of the FMU-68/B fuze qualification testing program:

1. Fuzes of the configuration existing at the start of the test series were not capable of aborting correctly.

2. Fuzes of the configuration existing at the start of the test series exhibited poor functional characteristics when dropped from 11.5 feet.

3. Fuzes with redesigned rotors showed good (68 of 69) abort characteristics.

4. Fuzes with a redesigned moisture seal at the adapter showed good function characteristics (67 of 67).

5. Sensitivity, expressed in height of fall of a fixtured fuze, is 7.3 inches nose up, 13.2 inches nose down, 13.7 inches horizontal.

6. The fuzes do not leak or degrade significantly when subjected to extreme climatic and salty atmosphere environments.

7. Vibration, of the types tested, does not degrade fuze performance.

8. Fuze performance under 40-G arming environment is acceptable (29 of 30).

9. Harsh physical environments such as jolt, jumble, and 40-foot drop do not cause a dangerous situation. A high percentage of fuzes will function properly after being subjected to jolt and jumble test environments.

10. A five-foot free-fall drop does not degrade fuze performance.

On the basis of the test results and interpretations contained in various sections of this document, the latest configuration of the FMU-68/B fuze should exhibit acceptable performance under operational conditions.

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13. ABSTRACT

This report covers the qualification testing (~~conducted under the~~ direction of the ~~Air Force Armament Laboratory, ATCC, Eglin~~ AFB)of the FMU-68/B fuze. The test program consisted of an evaluation of the performance and sensitivity characteristics of 436 fuzes in applicable MIL-STD environments. During the tests, data were accumulated showing that the fuze had a function reliability of 0.973 at the 0.90 confidence level and an abort reliability of 0.956 at the 0.90 confidence level. These high reliability levels indicate that the FMU-68/B fuze is apparently qualified for Air Force use.

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14. KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
Centerplate						
Abort Clip						
Arming Time						

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